

Algebra Date _____

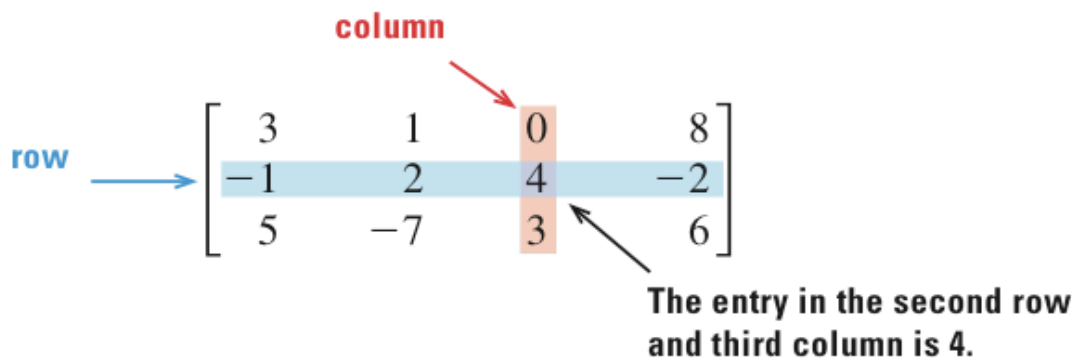
Matrices (pp 86–88)

2.4 Notes: Adding & Subtracting

Goals

1. Organize data into a matrix.
2. State the dimensions of a matrix.
2. Add & subtract matrices.

A **matrix** is a rectangular arrangement of numbers into horizontal rows and vertical columns. Each number in the matrix is called an **entry** or an **element**. (The plural of *matrix* is *matrices*.)



The size of a matrix is described as follows.

(the number of **rows**) \times (the number of **columns**)

The matrix above is a 3×4 (read “3 by 4”) matrix, because it has three rows and four columns. Think of a matrix as a type of table that can be used to organize data.

Two matrices are equal if the entries in corresponding positions are equal.

$$\begin{bmatrix} 3 & -2 \\ \frac{1}{2} & 0 \end{bmatrix} = \begin{bmatrix} 3 & -2 \\ 0.5 & 0 \end{bmatrix} \quad \begin{bmatrix} -4 & 7 \\ 0 & -1 \end{bmatrix} \neq \begin{bmatrix} 7 & -4 \\ 0 & -1 \end{bmatrix}$$

To add or subtract matrices, you add or subtract corresponding entries. Each matrix must have the same number of rows and columns. For instance, you cannot add a matrix that has three rows to a matrix that has only two rows.

EXAMPLE 1 *Writing a Matrix*

Write a matrix to organize the following information about your CD collection.

Country: 4 groups, 6 solo artists, 0 collections

Rock: 8 groups, 3 solo artists, 3 collections

Blues: 1 group, 5 solo artists, 2 collections

SOLUTION

Country, *Rock*, and *Blues* can be labels for the rows or for the columns.

AS ROW LABELS:				AS COLUMN LABELS:			
	Group	Solo artist	Collection		Country	Rock	Blues
Country	4	6	0	Group	4	8	1
Rock	8	3	3	Solo artist	6	3	5
Blues	1	5	2	Collection	0	3	2

1. Example: Write a matrix to organize the following information.

High school: 5 entrees, 3 desserts, 5 drinks

Middle school: 3 entrees, 2 desserts, 4 drinks.

EXAMPLE 2 *Adding and Subtracting Matrices*

$$\begin{aligned} \text{a. } \begin{bmatrix} 4 & 2 \\ 0 & -3 \\ -5 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 2 & -1 \\ 6 & -4 \end{bmatrix} &= \begin{bmatrix} 4+1 & 2+0 \\ 0+2 & -3+(-1) \\ -5+6 & 1+(-4) \end{bmatrix} \\ &= \begin{bmatrix} 5 & 2 \\ 2 & -4 \\ 1 & -3 \end{bmatrix} \end{aligned}$$

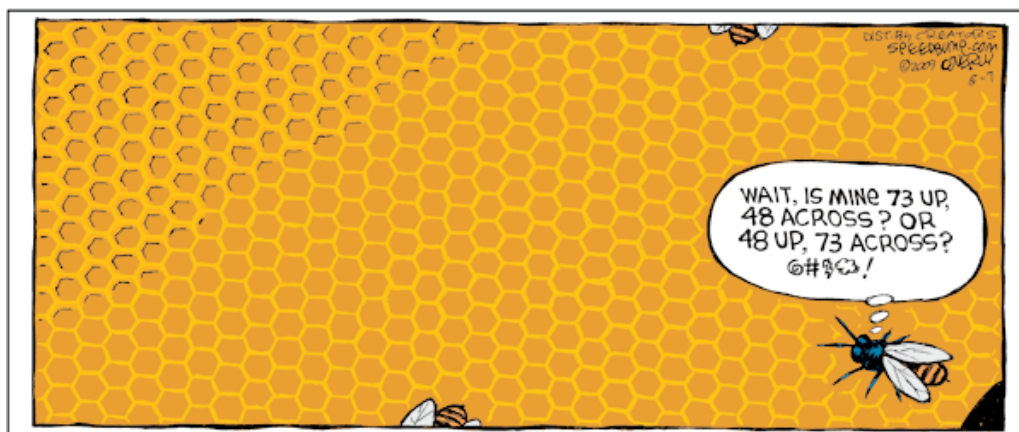
$$\begin{aligned} \text{b. } \begin{bmatrix} 10 & -6 \\ 5 & 0 \end{bmatrix} - \begin{bmatrix} 4 & 5 \\ -3 & 2 \end{bmatrix} &= \begin{bmatrix} 10-4 & -6-5 \\ 5-(-3) & 0-2 \end{bmatrix} \\ &= \begin{bmatrix} 6 & -11 \\ 8 & -2 \end{bmatrix} \end{aligned}$$

2.


$$\begin{bmatrix} 3 & -1 & 0 \\ 2 & 1 & 5 \end{bmatrix} + \begin{bmatrix} -3 & 1 & 6 \\ 2 & 0 & -8 \end{bmatrix}$$

SPEED BUMP

BY DAVE COVERLY



EXAMPLE 3 *Political Composition of U.S. Congress*

CONGRESS The United States Congress is composed of the House of Representatives and the Senate. The matrices below show the number of men and women in the Senate and the House at the 1999 start of the 106th Congress. Write and label a single matrix that shows the number of men and women in Congress in 1999.  **DATA UPDATE** of United States Congress data at www.mcdougallittell.com

HOUSE			SENATE		
	Men	Women		Men	Women
Democrat	172	39	Democrat	39	6
Republican	206	17	Republican	52	3
Other	1	0	Other	0	0

SOLUTION Add the two matrices. Then label the result.

$$\begin{bmatrix} 172 & 39 \\ 206 & 17 \\ 1 & 0 \end{bmatrix} + \begin{bmatrix} 39 & 6 \\ 52 & 3 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 211 & 45 \\ 258 & 20 \\ 1 & 0 \end{bmatrix}$$

► The result can be written as follows.

	CONGRESS	
	Men	Women
Democrat	211	45
Republican	258	20
Other	1	0

3.

$$\begin{bmatrix} 4 & -3 & 4 \\ 3 & 0 & -2 \end{bmatrix} - \begin{bmatrix} 0 & 3 & 1 \\ -1 & 2 & -1 \end{bmatrix}$$

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4. The matrices show the House and the Senate in 1917. Write and label a single matrix that shows the number of men and women in Congress in 1917.

House	Men	Women	Senate	Men	Women
Democrat	210	0	Democrat	53	0
Republican	215	1	Republican	42	0
Other	9	0	Other	1	0

5. The matrices below show the inventory of an auto dealership before a delivery and the cars that were delivered. Write and label a single matrix that gives the auto dealership's inventory after the delivery.

Before	SUVs	Cars	Delivered	SUVs	Cars
Compact	15	18	Compact	5	7
Full Size	21	29	Full Size	9	16
Luxury	12	2	Luxury	3	1

ORGANIZING DATA As you learned in Example 1, matrices are a useful way to organize and keep track of data. For example, if you have a business, it is important to keep track of revenue (or income) and expenses (or costs). You can find out how much profit has been made by subtracting expenses from revenue. If the profit is a negative number, you lost money.



EXAMPLE 4 Finding a Profit Matrix

You own two stores that sell household appliances. The matrices below show revenue and expenses for three months at each store.

REVENUE (\$)			EXPENSES (\$)		
	Store 1	Store 2		Store 1	Store 2
January	78,432	109,345	January	59,426	98,459
February	82,529	120,429	February	64,372	104,972
March	94,311	118,782	March	85,456	120,833

- Write a matrix that shows the monthly profit for each store.
- Which store had higher overall profits during the three-month period?
- Which store lost money? In which month?

SOLUTION

Profit is the difference of revenue and expenses.

- To find the *profit matrix*, you can subtract the *expenses matrix* from the *revenue matrix*.

$$\begin{bmatrix} 78,432 & 109,345 \\ 82,529 & 120,429 \\ 94,311 & 118,782 \end{bmatrix} - \begin{bmatrix} 59,426 & 98,459 \\ 64,372 & 104,972 \\ 85,456 & 120,833 \end{bmatrix} = \begin{bmatrix} 19,006 & 10,886 \\ 18,157 & 15,457 \\ 8,855 & -2,051 \end{bmatrix}$$

- Label the matrix to identify the monthly profit at each store.

PROFIT (\$)		
	Store 1	Store 2
January	19,006	10,886
February	18,157	15,457
March	8,855	-2,051

- Add the entries in each column of the profit matrix to find the total profit for each store during the three-month period.

$$\text{Store 1: } 19,006 + 18,157 + 8,855 = \$46,018$$

$$\text{Store 2: } 10,886 + 15,457 + (-2,051) = \$24,292$$

- Store 1 had higher overall profits.

- Store 2 had a negative profit of $-2,051$ in March. This means the store lost \$2,051 during March.

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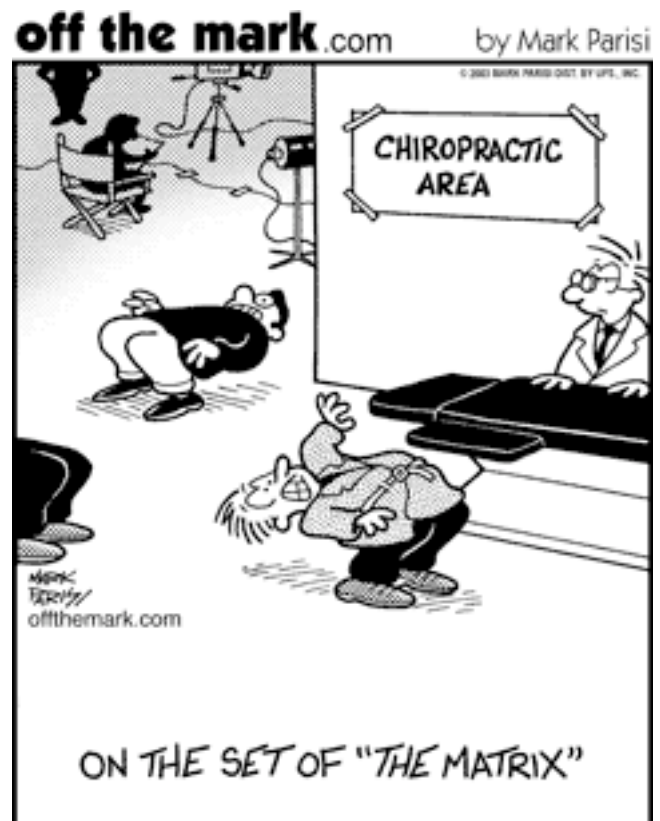
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Example: You own a restaurant that has two different locations. The matrices show revenue and expenses for 3 months at each location.

Revenue (\$)	Loc. 1	Loc. 2	Expenses (\$)	Loc. 1	Loc. 2
June	31,042	46,712	June	30,114	43,998
July	42,793	40,670	July	42,997	37,940
August	33,061	42,543	August	32,003	41,056

6. Write a matrix that shows the monthly profit for each location.
7. Which location had higher overall profits during the 3-month period?
8. Which location lost money? In which month?



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The Revenue and Expenses for two medical offices for a 2-month period are shown.

Revenue (\$)	Office 1	Office 2
April	11,041	9614
May	14,397	8462

Expenses (\$)	Office 1	Office 2
April	10,914	9026
May	13,142	6489

9. Write a matrix that shows the monthly profit for each office.

10. Which office has the higher overall profit during the 2-month period?

11. _____

$$\begin{bmatrix} 3 & 2 \\ 4 & -6 \end{bmatrix} - \begin{bmatrix} 1 & -2 \\ 5 & -4 \end{bmatrix} = \underline{\hspace{2cm}}$$

(A) $\begin{bmatrix} 2 & 0 \\ -1 & -10 \end{bmatrix}$

(B) $\begin{bmatrix} 2 & 4 \\ -1 & -10 \end{bmatrix}$

(C) $\begin{bmatrix} 2 & 0 \\ -1 & -2 \end{bmatrix}$

(D) $\begin{bmatrix} 2 & 4 \\ -1 & -2 \end{bmatrix}$

(E) $\begin{bmatrix} 2 & 0 \\ -1 & 2 \end{bmatrix}$

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12. How many rows are there in the matrix at the right?
How many columns?

$$\begin{bmatrix} 5 & -7 & 3 \\ 2 & -2 & -4 \end{bmatrix}$$

13. Is the matrix at the right a 3×2 matrix or a 2×3 matrix?

14. Use the matrix showing the number of Democratic and Republican members of the House of Representatives from Arkansas, Delaware, and North Dakota. What is the entry in the first row and second column? What does the number represent?

	Democrat	Republican
AR	2	2
DE	1	0
ND	0	1

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